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(54) Automatic treadmill

(57) An automatic treadmill comprises a track mechanism 1 wherein the rotation speed of the tread belt 12 is automatically controlled to suit the physical condition of the user, and a slope adjusting means 2 is associaed with the track mechanism 1 to enable the track mechanism to operate at a slope. The treadmill further comprises a controller 3 having a microprocessor formed therein for inputting control data, processing and recording operation status data, and outputing/displaying those stored data. There are photo counters or limit switches used as sensors to collect various exercise data such as speed, distance, slope, pulse rate, duration, etc. The controller 3 will automatically enable the treadmill to operate in accordance with a pre-determinated sequence of functions, and will, at the same time, store/display exercise data, such as the pulse rate, pace, number of steps taken, heat dissipated, etc.

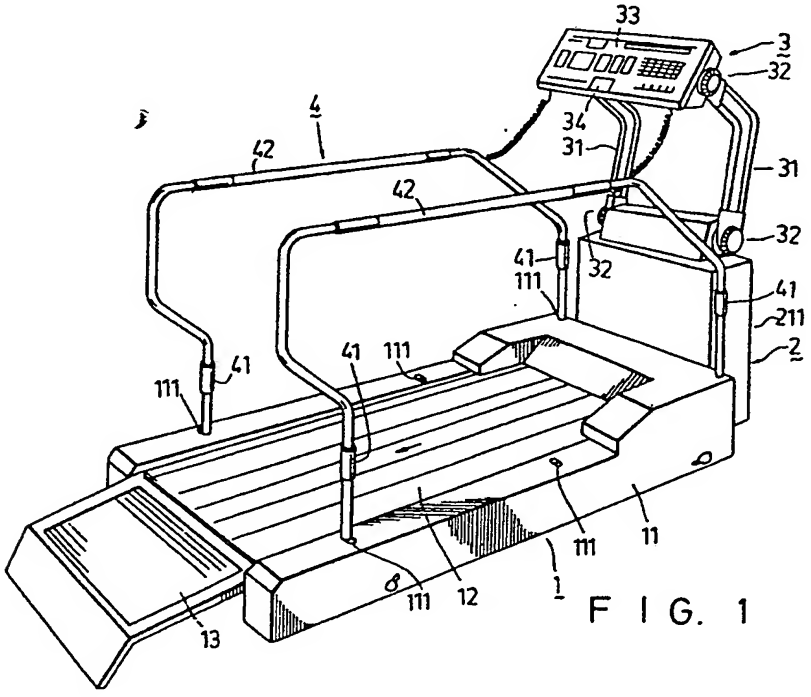

FIG. 1

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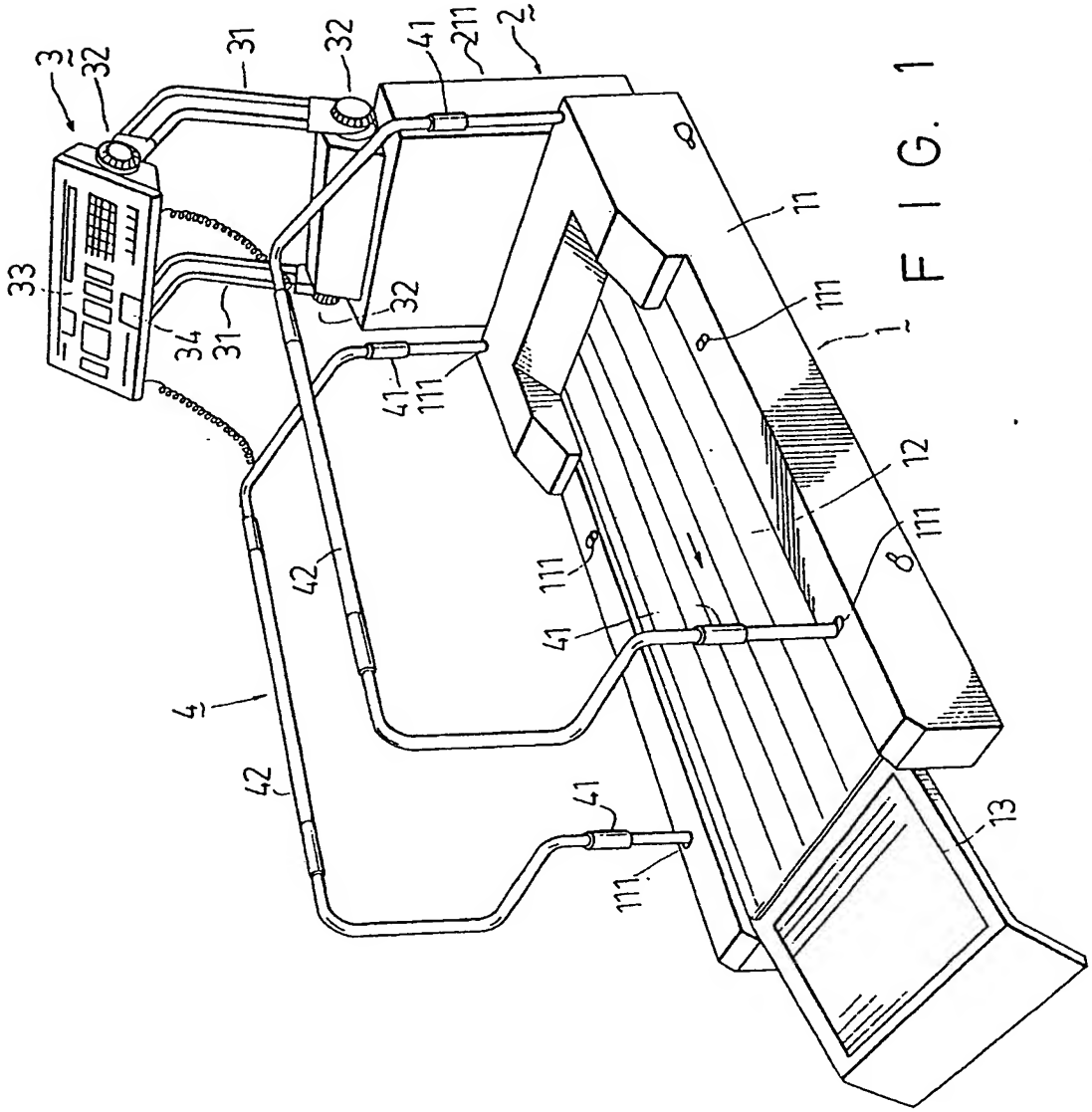

FIG. 1

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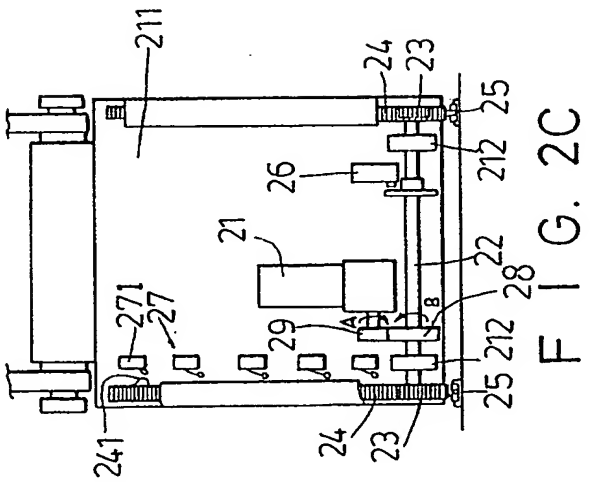

FIG. 2C

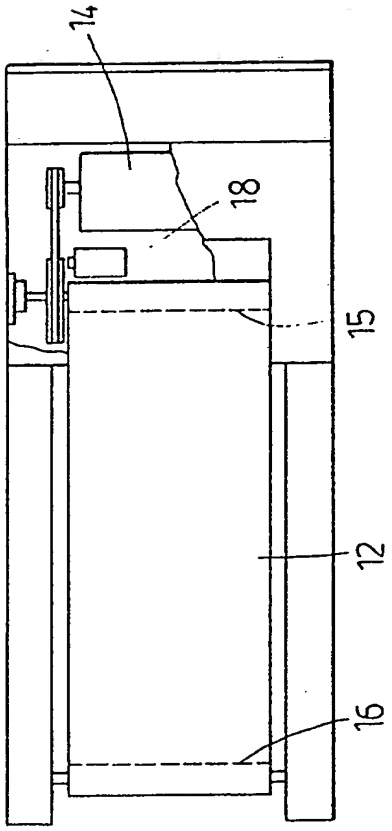

FIG. 2B

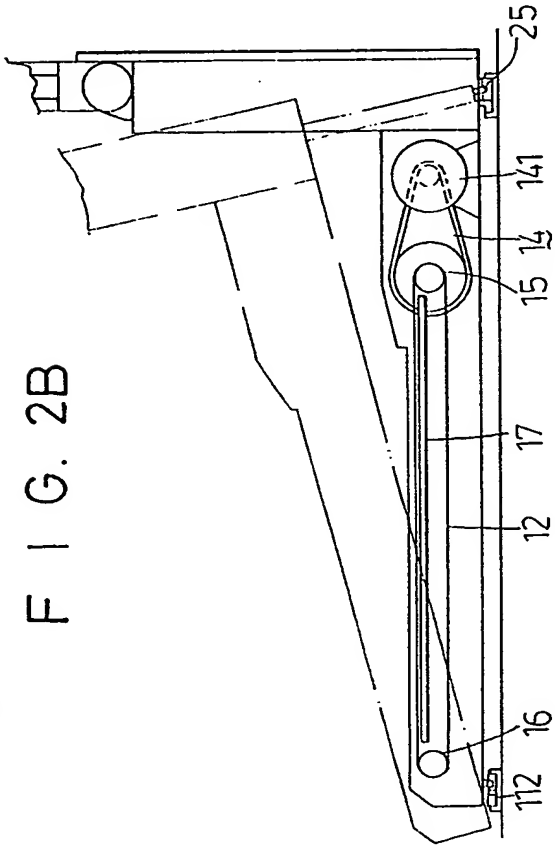

FIG. 2A

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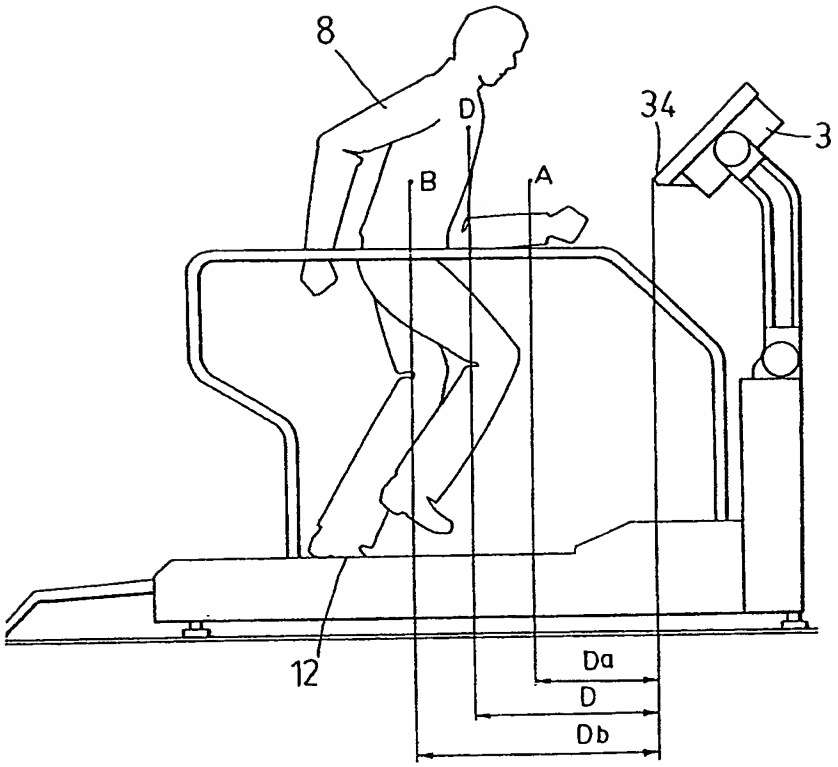

FIG. 3

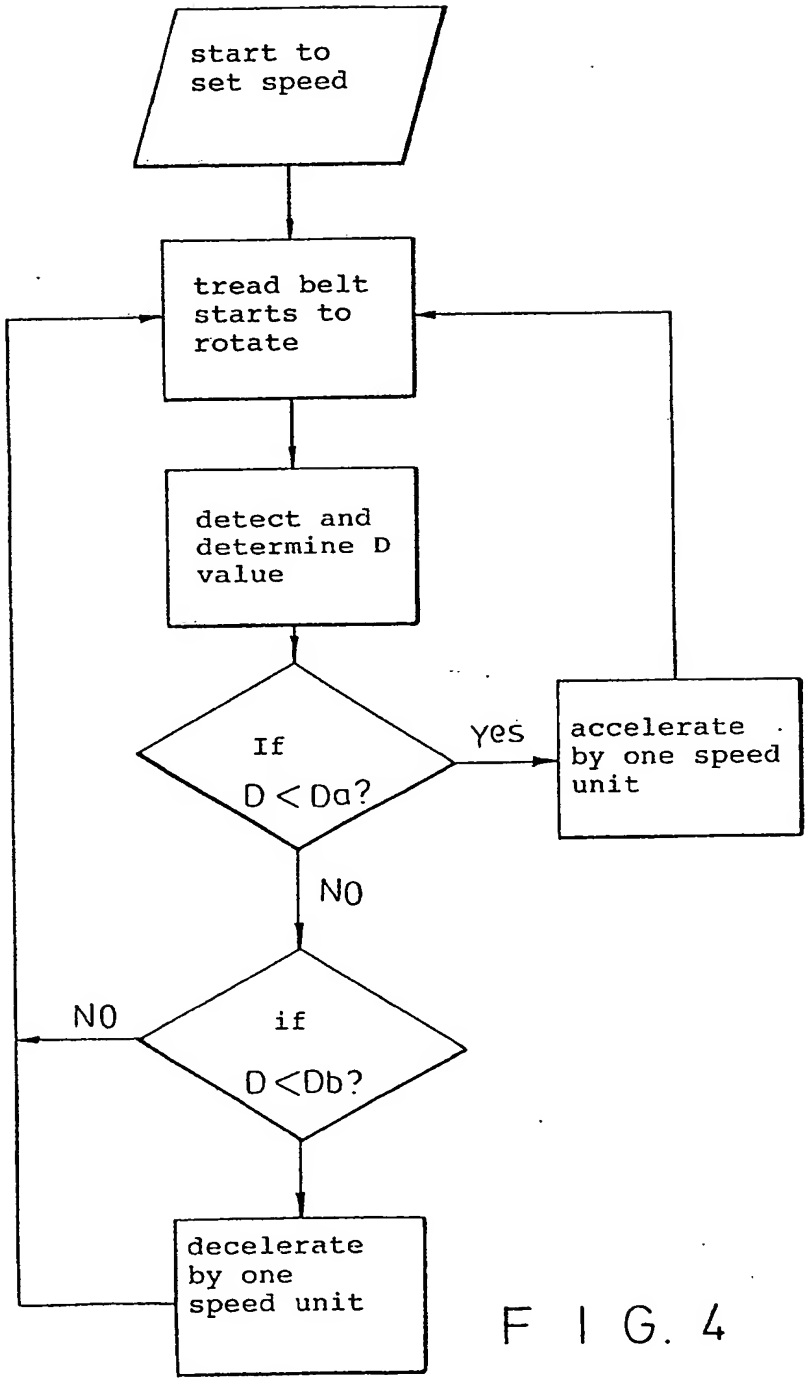
start to set speed
tread belt starts to rotate
detect and determine D value
If D < Da?
Yes
accelerate by one speed unit
NO
if D < Db?
NO
decelerate by one speed unit

FIG. 4

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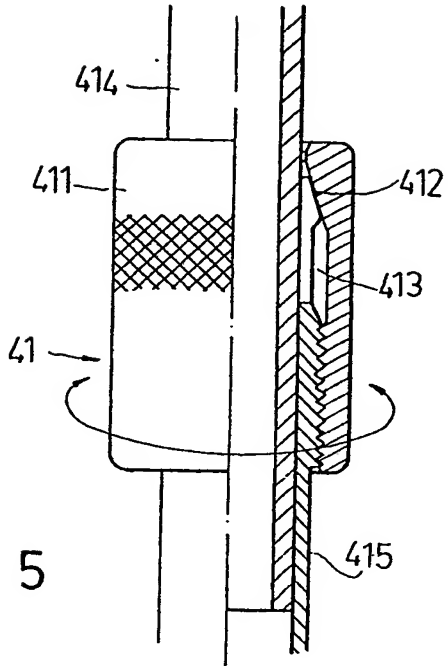
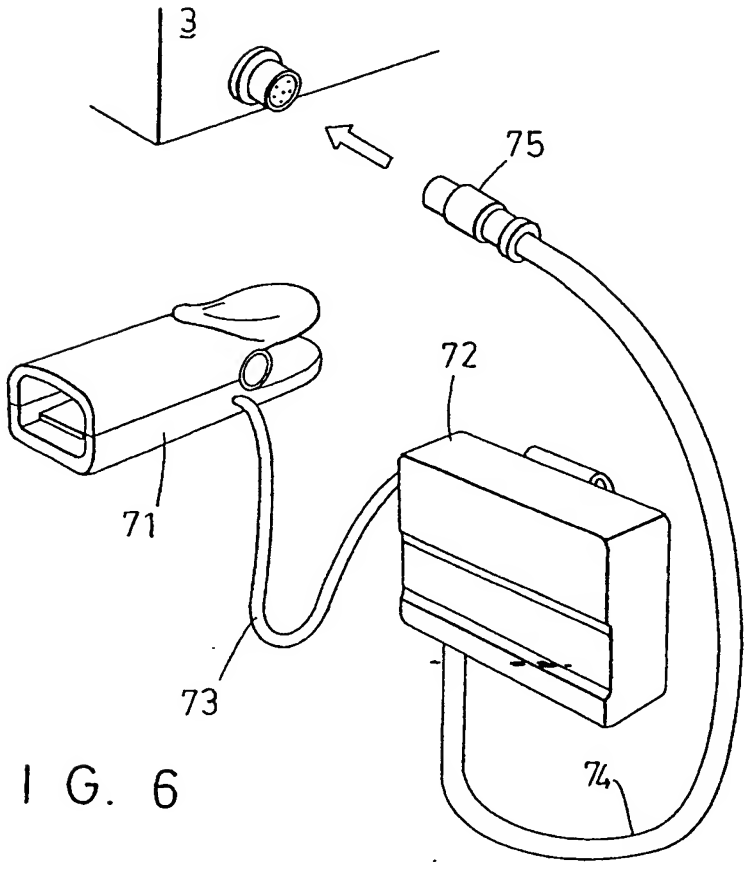


F I G. 5



F I G. 6

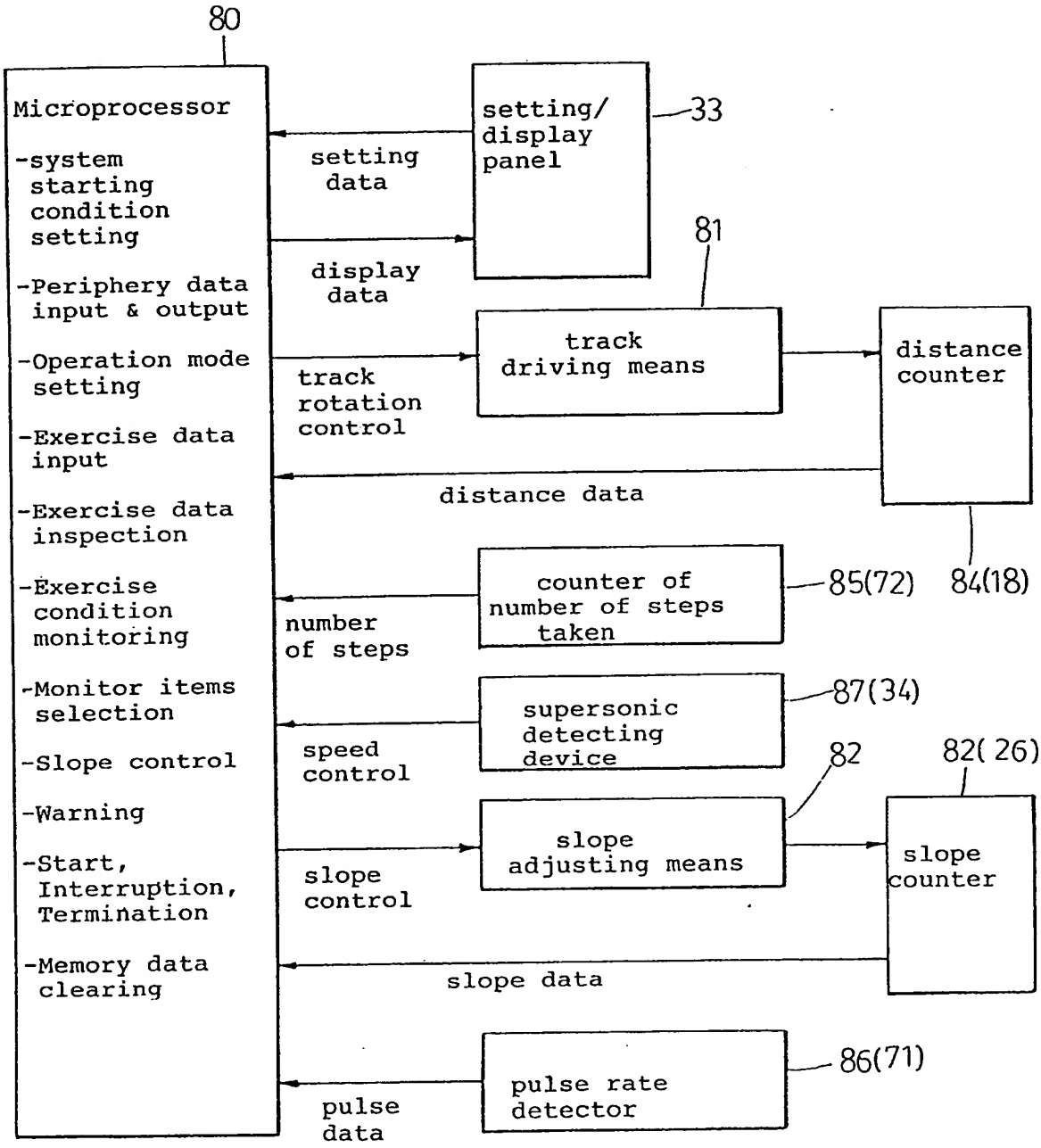

80
Microprocessor
-system starting condition setting
-Periphery data input & output
-Operation mode setting
-Exercise data input
-Exercise data inspection
-Exercise condition monitoring
-Monitor items selection
-Slope control
-Warning
-Start, Interruption, Termination
-Memory data clearing
setting data
display data
track rotation control
number of steps
speed control
slope control
slope data
pulse data
setting/ display panel
33
81
track driving means
distance counter
distance data
counter of number of steps taken
85(72)
84(18)
supersonic detecting device
87(34)
82
82(26)
slope adjusting means
slope counter
pulse rate detector
86(71)

FIG. 7

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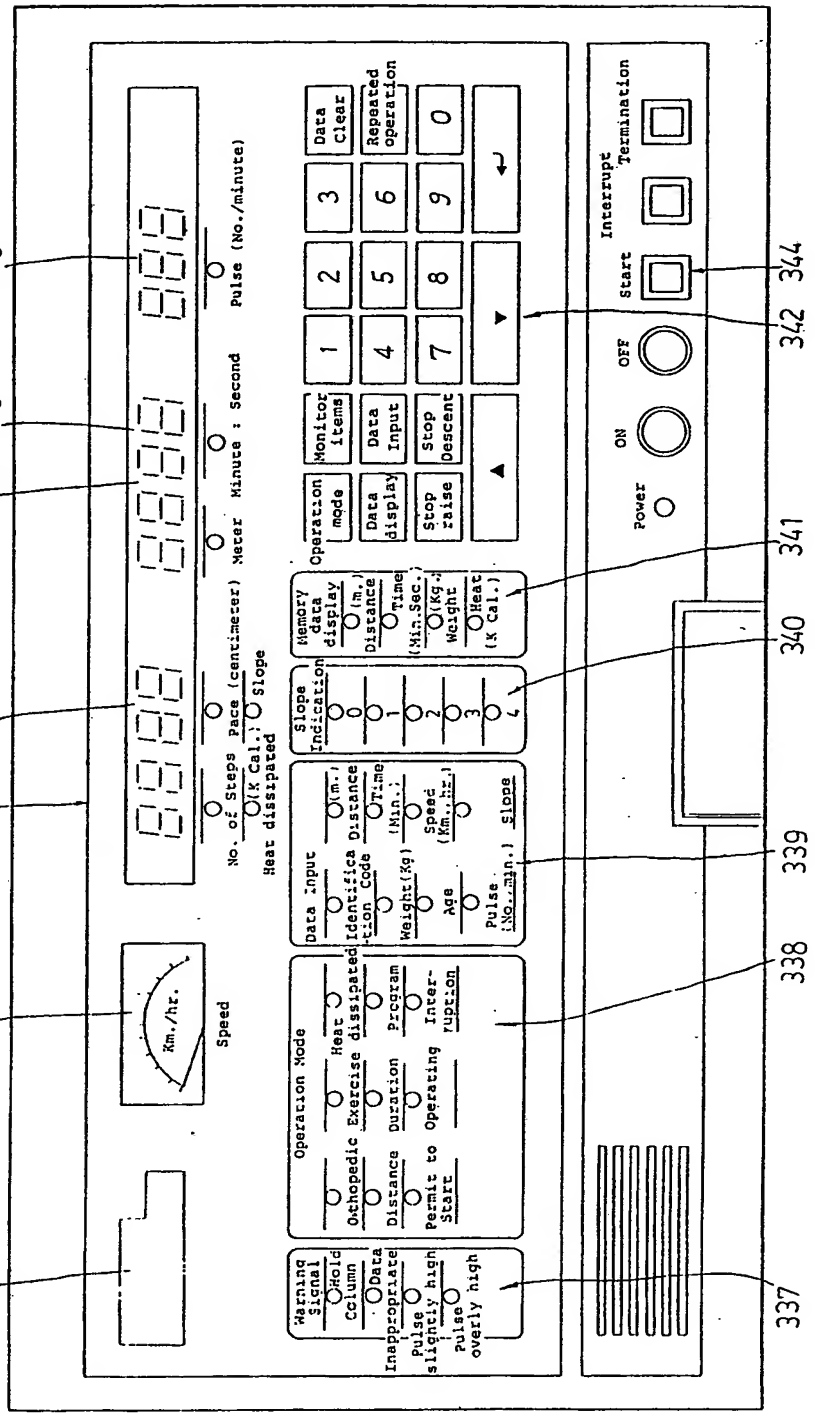


FIG. 8

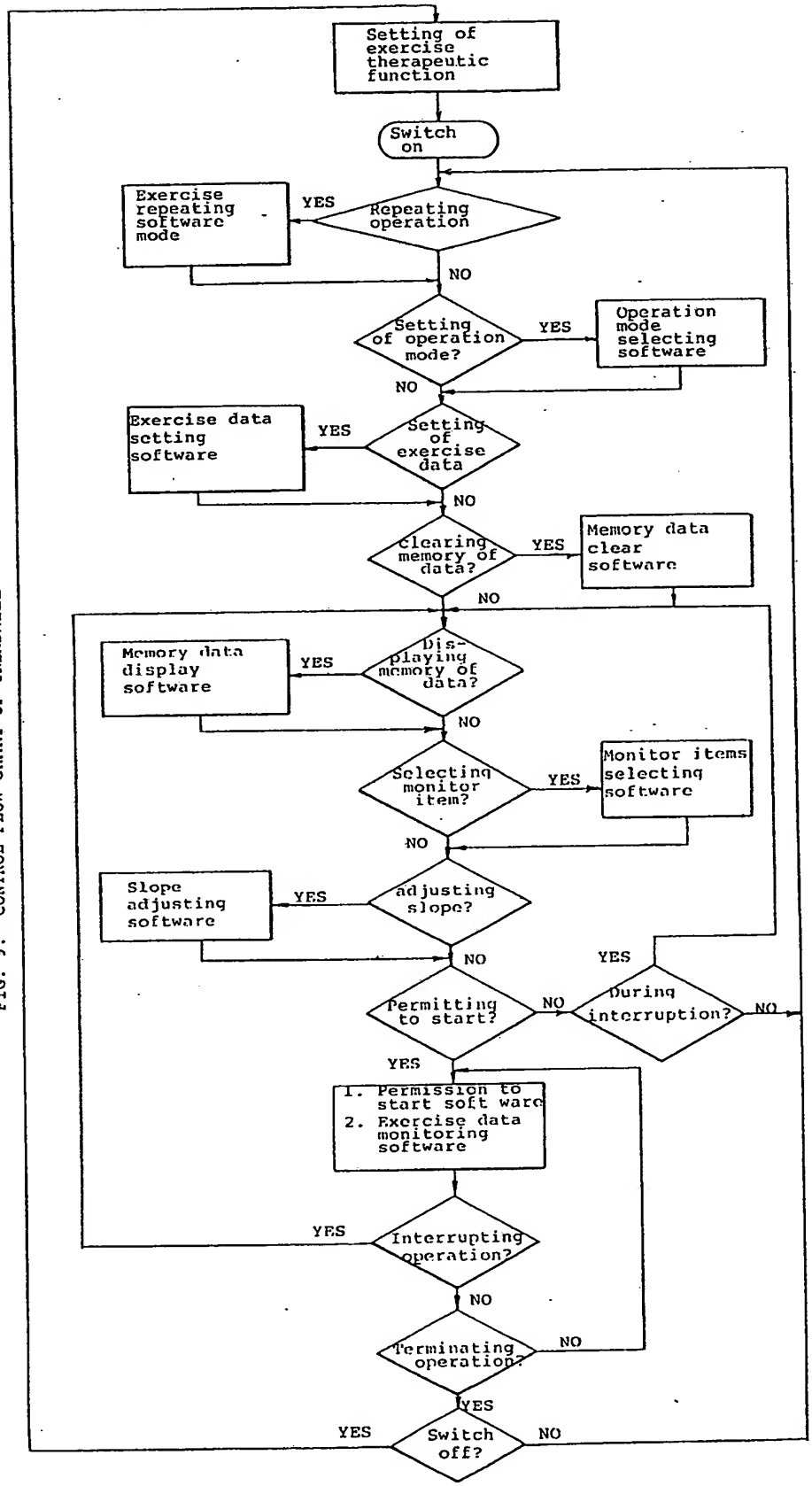


FIG. 9. CONTROL FLOW CHART OF TREADMILL

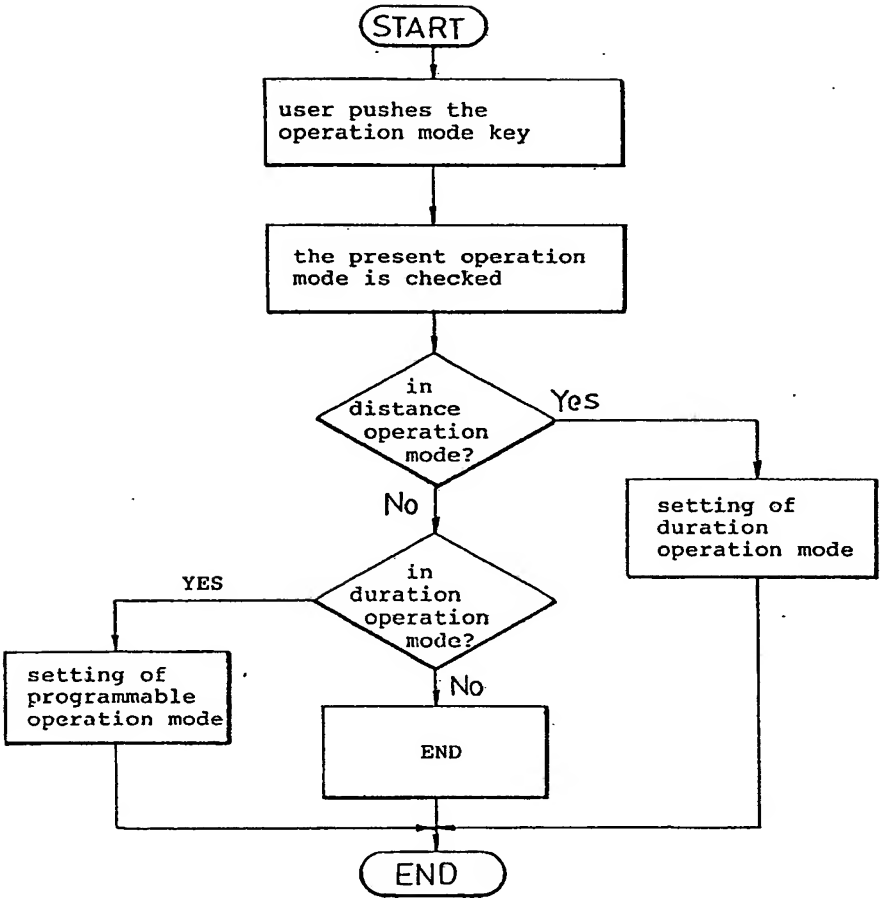


FIG. 10 Flow Chart for Setting of Operation Mode

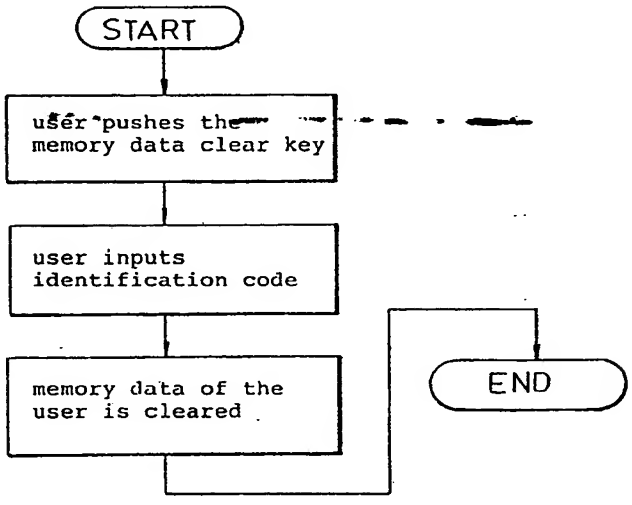


FIG. 11.Flow Chart for Clearing Memory Data

FIG. 12. FLOW CHART FOR REPEATING OPERATION

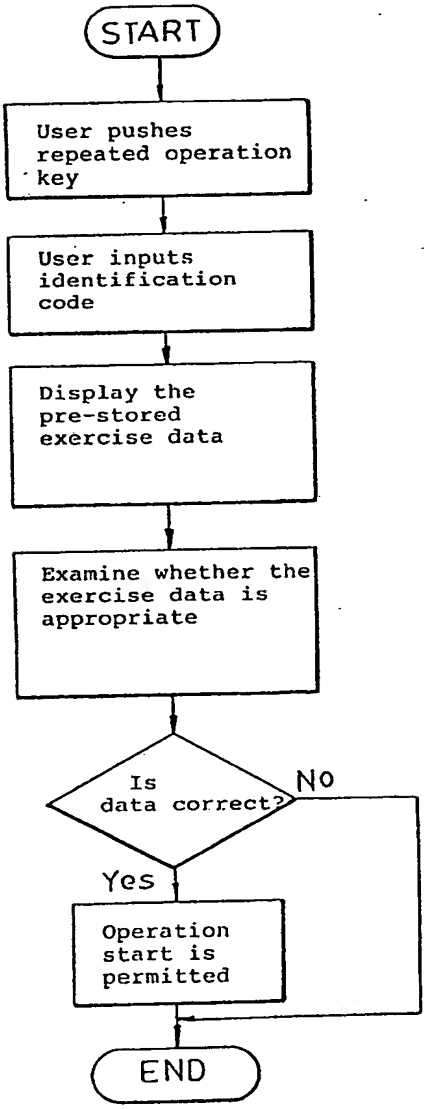
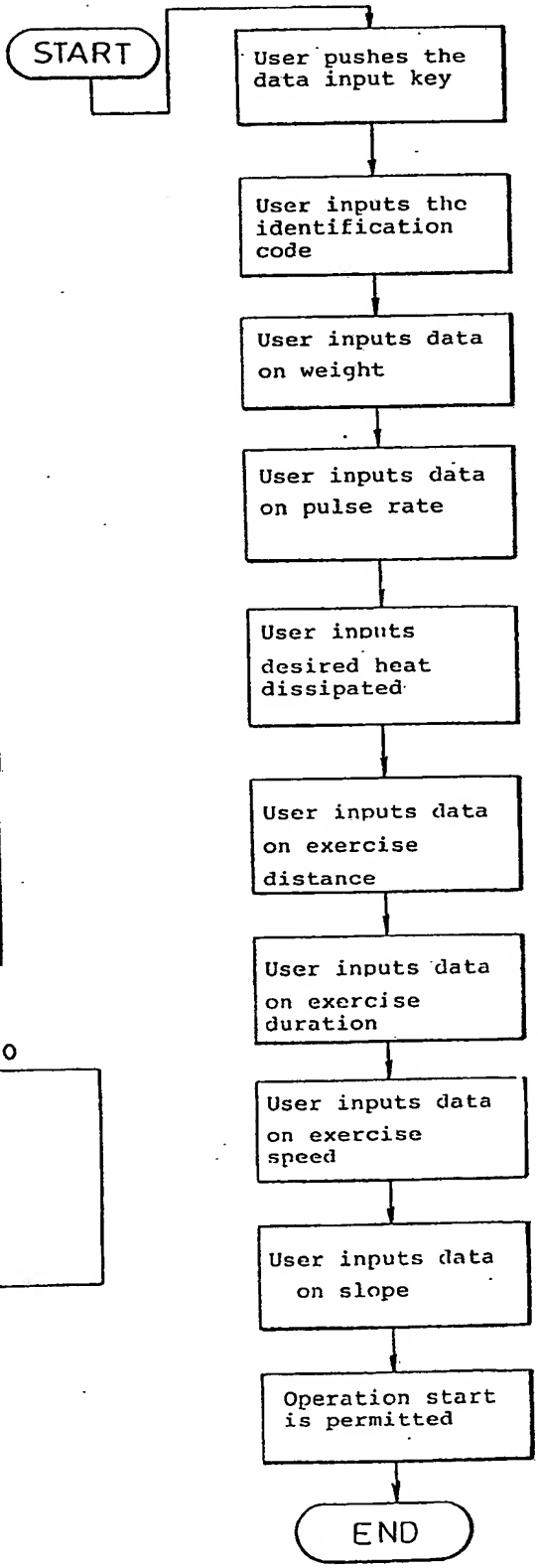


FIG. 13. FLOW CHART FOR EXERCISE DATA SETTING



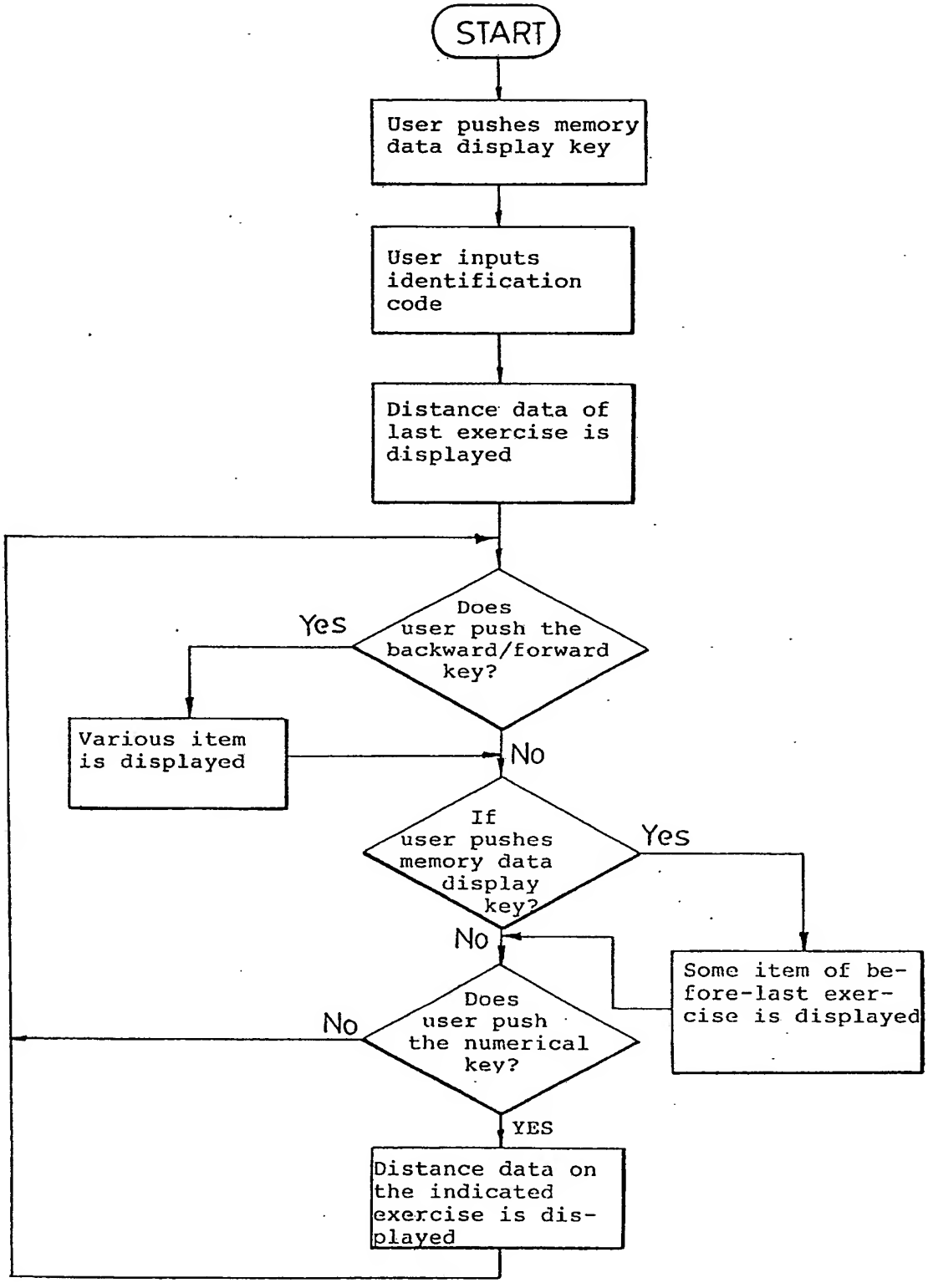


FIG. 14. FLOW CHART FOR DISPLAY MEMORY DATA

FIG. 15-1 FLOW CHART FOR EXERCISE DISTANCE MONITOR

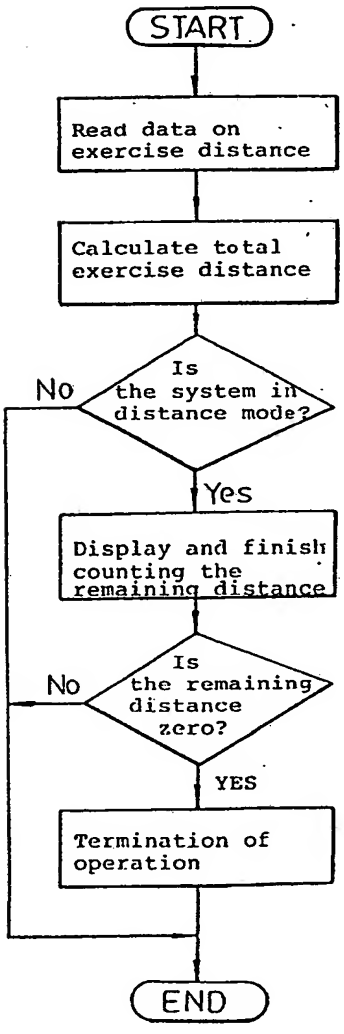
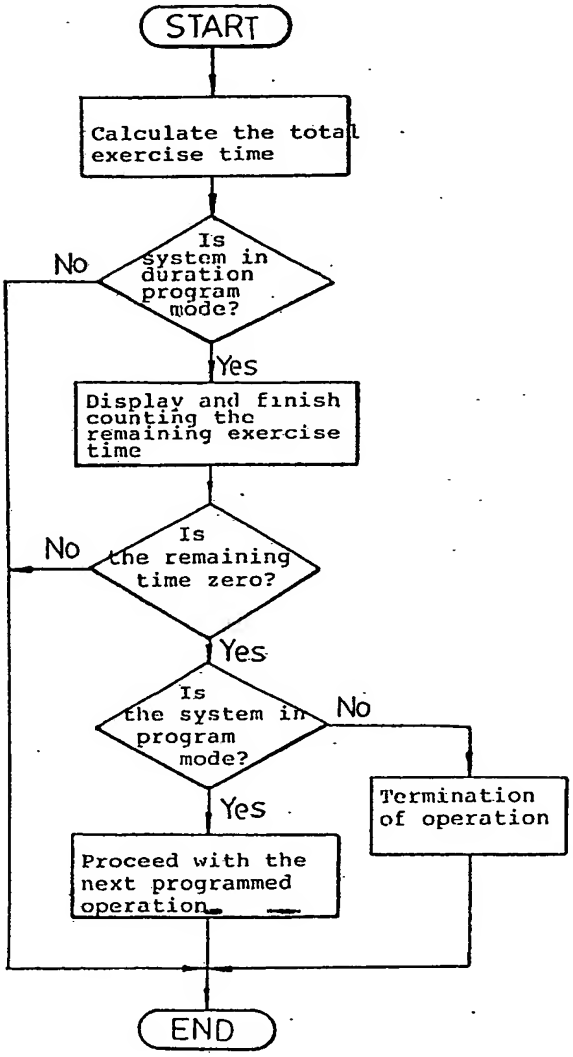


FIG.15-2 FLOW CHART FOR EXERCISE DURATION MONITOR



Remark: The exercise duration monitoring will be executed once per second

FIG. 15-3
FLOW CHART FOR MONITOR
OF NUMBER OF STEPS

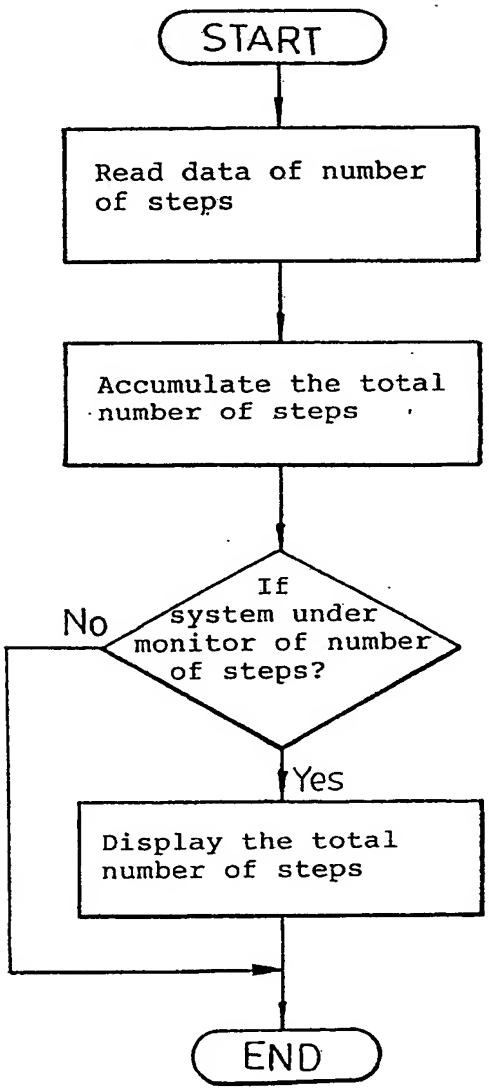
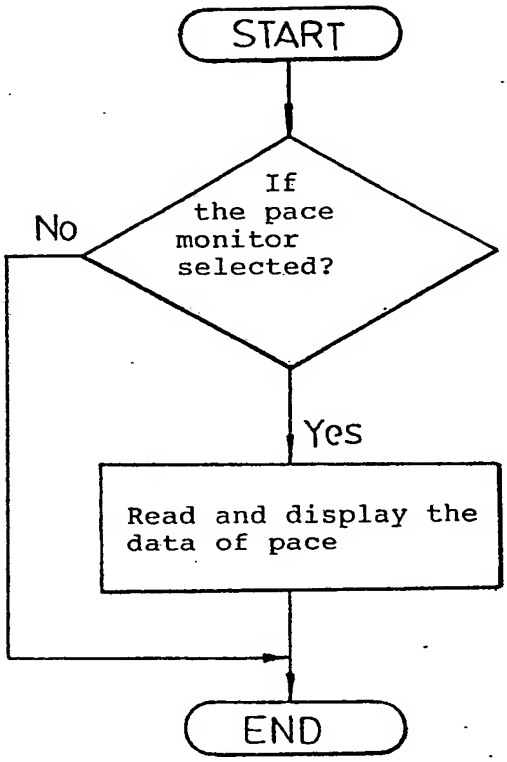


FIG. 15-4
FLOW CHART FOR
PACE MONITOR



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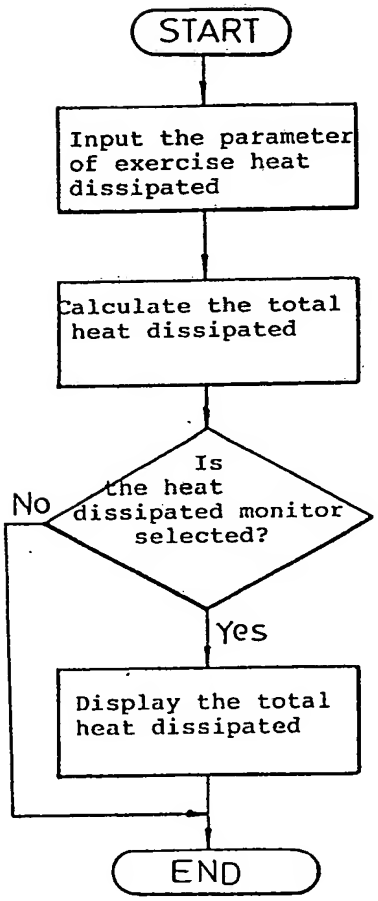

FIG. 15-5. FLOW CHART FOR MONITOR OF HEAT DISSIPATED

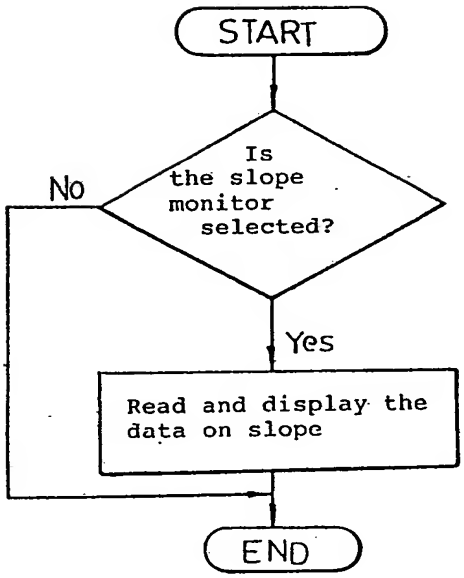

FIG. 15-6. FLOW CHART FOR MONITOR OF SLOPE

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FIG. 15-7

FLOW CHART FOR EXERCISE SPEED MONITOR

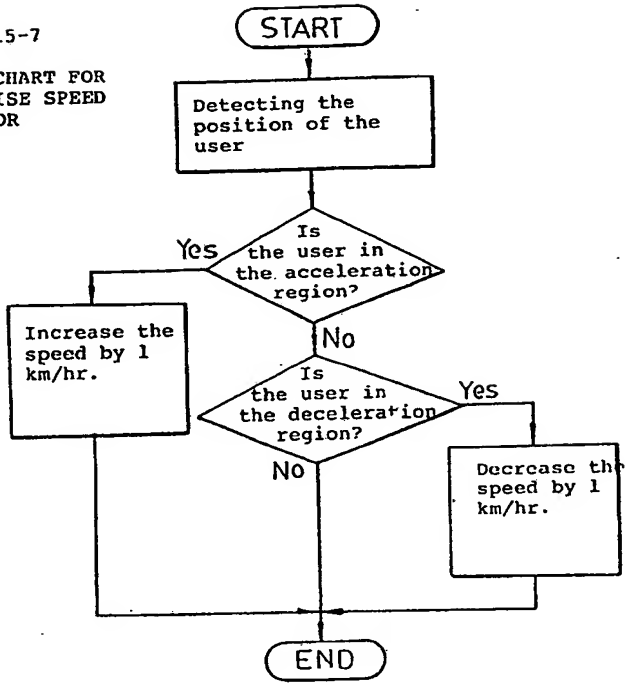
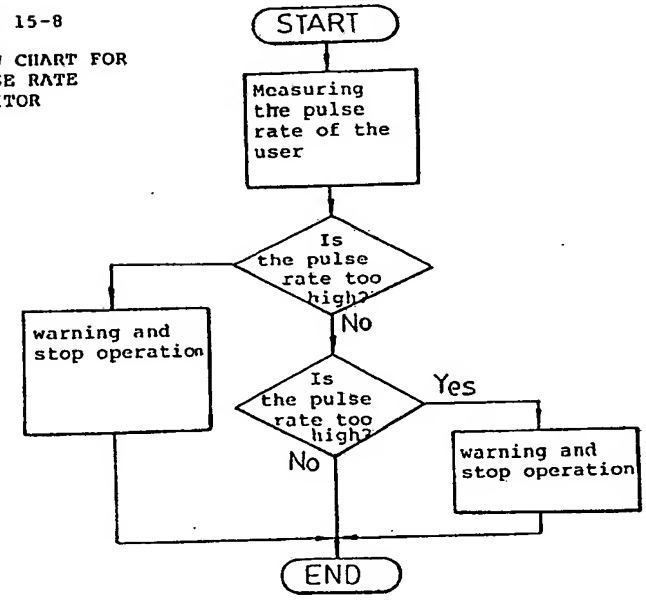


FIG. 15-8

FLOW CHART FOR PULSE RATE MONITOR



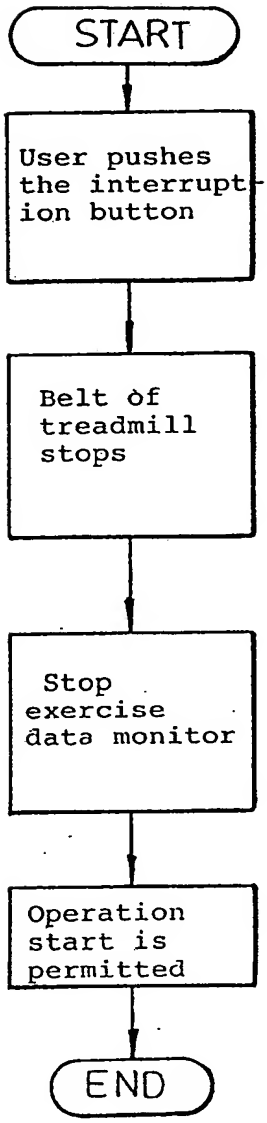


FIG. 16

FLOW CHART FOR INTERRUPTION OF OPERATION

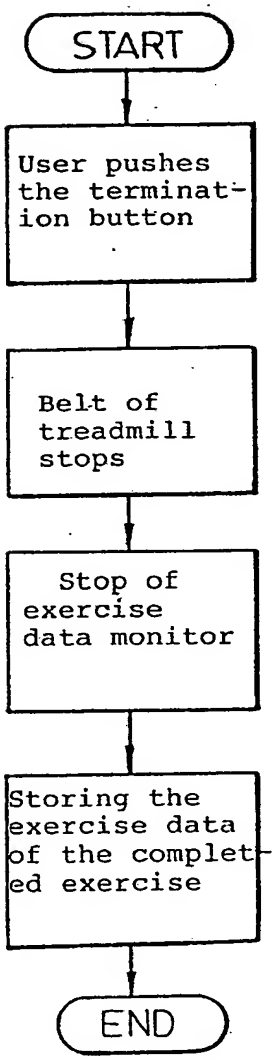


FIG. 17

FLOW CHART FOR TERMINATION OF OPERATION

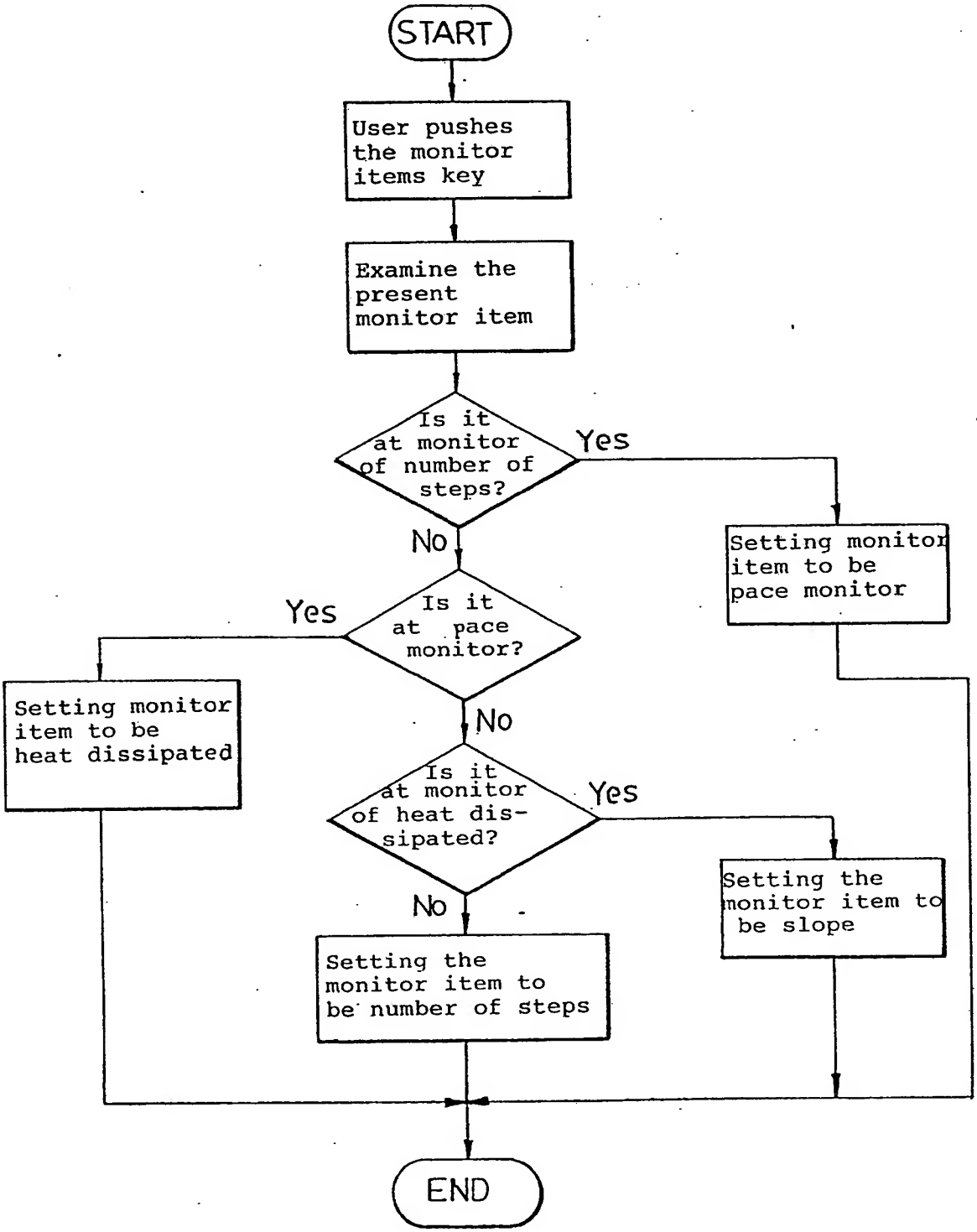


FIG. 18 FLOW CHART FOR SELECTING MONITOR ITEM

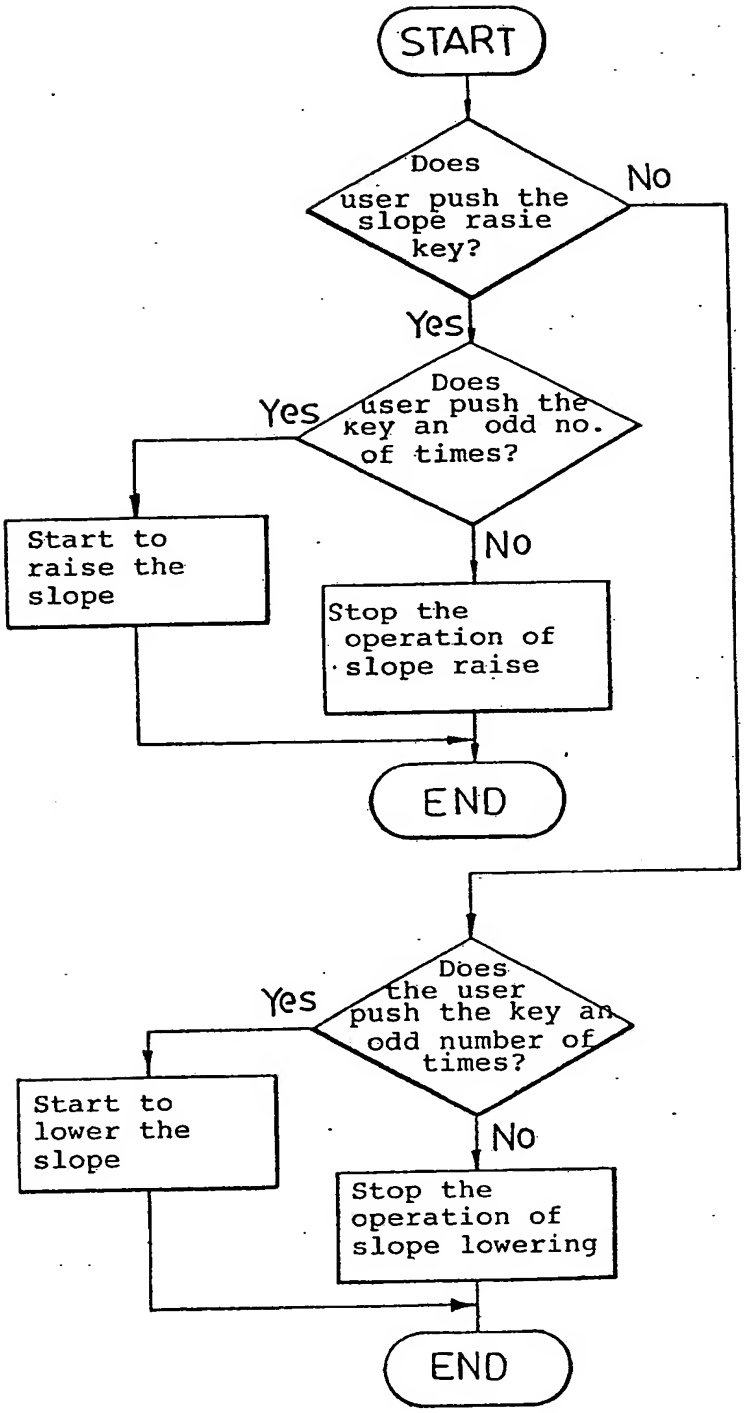


FIG. 19 FLOW CHART FOR SLOPE ADJUSTMENT

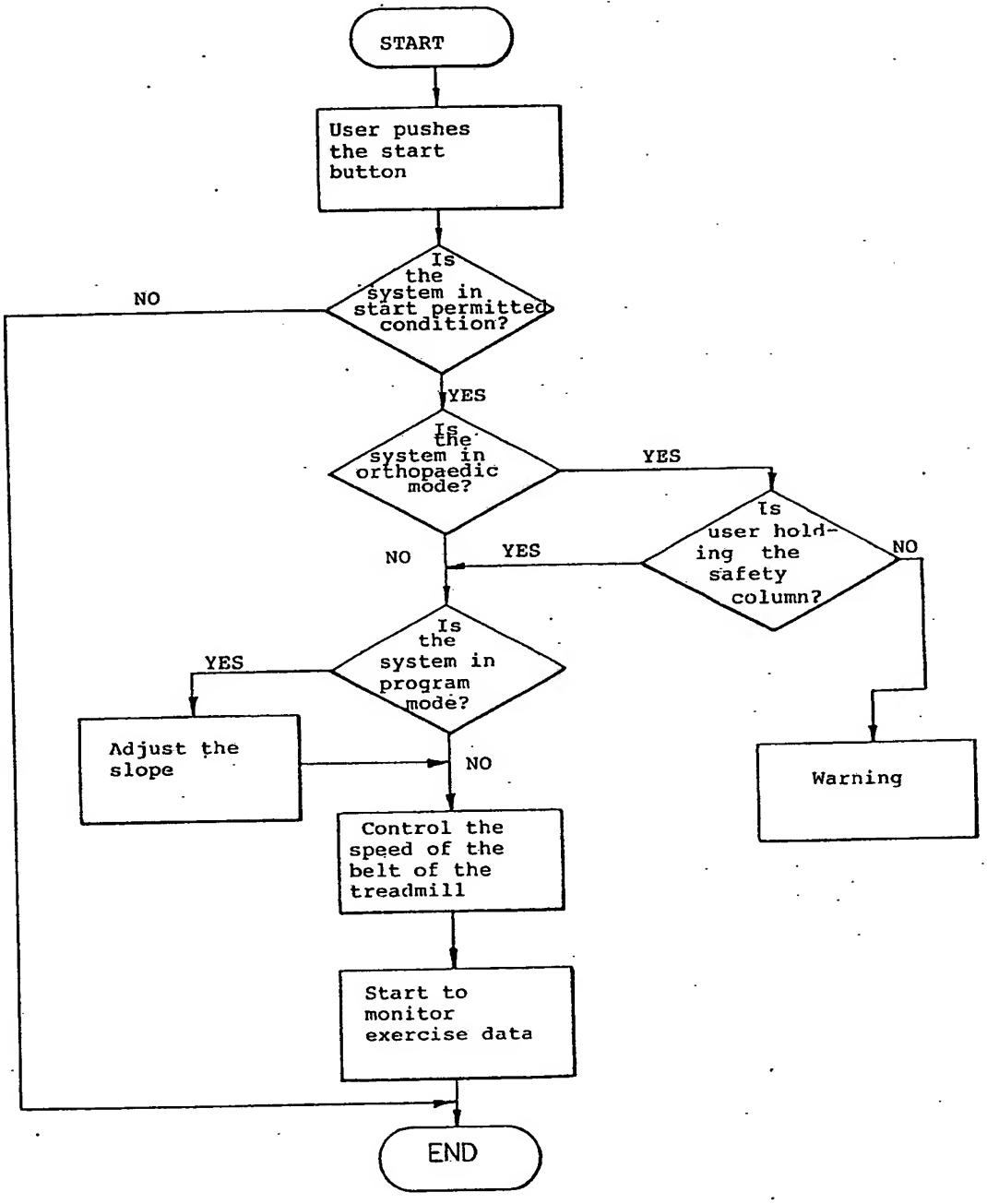


FIG. 20 FLOW CHART FOR START OPERATION

SPECIFICATION

Automatic treadmill

The present invention relates to a treadmill, particularly to one capable of automatically choosing different operation modes and displaying the physical condition of the user during its use.

We know proper physical exercise may improve metabolism and enhances blood circulation. People need physical exercise to remain healthy. Howerver, in our modern daily life, most people do not have much time for outdoor physical exercise. Also, many people can or will not perform serious physical exercise outdoors because of factors such as their occupation, personality or physical obstacles such as having had a stroke.

Recently, treadmills for people to walk or run on have become increasingly popular. The principal advantage of a treadmill is that it is handy for indoor physical exercise. However, conventional treadmills have several disadvantages. The most commonly used treadmill has only a rotatable tread belt for user to stand upon and walk or run on. Because the speed of rotation of the tread belt is not adjustable, users do not have the same feeling as running outdoors. Besides, the flat tread belt is not like real ground which usually has bumps and slopes. Furthermore, conventional treadmills do not have any means for recording the physical state of the user and also have no display to let for the user to know his own physical condition so that he will not overexert himself.

The main object of the present invention is to provide an improved treadmill, especially an automatic one, which contains various features that conventional treadmills do not have.

Another object of the present invention is to provide a treadmill which can be used for ordinary running exercise and also for the purpose of orthopaedic training.

An important feature of the present invention is a supersonic detecting apparatus to sense and determine the position of the user and to generate an output signal to automatically control the rotating speed of the tread belt for the safety of the user.

Another feature of the treadmill according to the present invention is the adoption of a microprocessor for controlling the period of operation, angle and change of slope of the pave belt and also for displaying aspects of the physical condition of the user, such as his pulse rate.

A further feature of the treadmill according to the present invention is to provide a controller for receiving reference data of the user such as his age, weight, an identification code, etc. By using the controller, the user can set the operation mode of the treadmill and also have recordal and displayed all his exercise data.

To these objects, the treadmill of the present invention comprises a track means having a rotation driving means to rotate a tread belt on the track means and a slope adjusting means to adjust the slope of the track means, a controller connected to the track means for input of reference data and generation of control signals for operation mode, speed and slope adjustment, and a microprocessor having stored therein predetermined program for processing data input to the controller, generating output data and storing useful physical condition data concerning of the user.

Those and other objects, advantages and features of the treadmill according to the present invention will become apparent from the following detailed description of a preferred embodiment with reference to the accompanying drawings, wherein:

Figure 1 is a perspective view of the treadmill according to the present invention;

Figure 2A, 2B and 2C are illustrative front, top and right side views of the treadmill according to the present invention, showing the slope adjusting mechanism for the track;

Figure 3 is an illustrative elevation view showing the detection of the position of the user by the supersonic device;

Figure 4 is a flow chart for the speed control system program;

Figure 5 is a partial sectional view of the height adjusting means of the column;

Figure 6 is a perspective view of a linked set of pulse rate detector and a detector of number of steps taken;

Figure 7 is a structural diagram of the functions of the treadmill according to the present invention;

Figure 8 is an elevation diagram of a front panel of the controller of the treadmill according to the present invention;

Figure 9 is a flow chart of the program for the overall control system of the treadmill;

Figure 10 is a flow chart for the program of setting of te operation mode;

Figure 11 is a flow chart for the clearing memory data program;

Figure 12 is a flow chart for the program of repeating the operation;

Figure 13 is a flow chart for the exercise data setting program;

Figure 14 is a flow chart for the displaying memory data program;

Figures 15-1 to 15-8 are flow charts for the programs of monitors for exercise distance, exercise duration, number of steps, pace, heat dissipated, slope, speed, and pulse rate respectively;

Figure 16 is a flow chart for the program of interruption of the operation;

Figure 18 is a flow chart for the program of selecting monitor items;

Figure 19 is a flow chart for the slope adjustment program; and Figure 20 is a flow

chart for the starting operation program.

Referring to Fig. 1 which shown a perspective view of a treadmill of the present invention, the treadmill consists sutstantially of a track means 1, a slope adjusting means 2, a controller 3 and columns 4.

Still referring to Fig. 1 but with reference to Figs. 2A, 2B and 2C, the track means 1 consists of an outer casing 11 with a tread belt 12 installed in the middle portion thereof. There are series of fitting holes 111 formed on the outer casing 11 for the installation of the columns 4 and also for adjusting the distance between the two opposing columns 4. A front stand 13 is connected to the belt 12 of the track means 1 for the user's convenience in getting on and off the tread belt.

Referring now particularly to Figs. 2A and 2B, the track driving means 14 consists of a motor 141 connected by a rotation member 15 through a belt. The rotation member 15 is substantially in the shape of an elongated cylinder which will hold and stretch the belt 12 in cooperation with a second rotation member 16. There is a platform 17 beneath the belt 12 for supporting the weight of the user. A photo counter 18 is provided near the motor 141 for detecting the totel distance the belt 12 has rotated. The distance data will be input to the controller 3.

Referring to Fig. 2C, the slope adjusting means 2 consists of a vertical casing 211 with a reversible motor 21 installed therein. There is a gear 29 on the shaft of the motor 21 coupled to a passive gear 28 which is fixed on a horizontal axle 22. There are a pair of gears 23 at opposite two ends of the axle 22. The ,gears 23 are coupled to two racks 24, each of which has a bore fitted into a support 25. Two bearings 212 are sleeved on axle 22 and connected onto the vertical casing 211. Also on the casing 211 are provided a plurality of limit switches 27 along and beside the racks 24. Each limit switch 27 represents a certain predetermined slope of the track means 1. In operation, when motor 21 starts to rotate in a direction A, the axle 22 together with the gears 23 thereon will rotate in the direction B through the coupling of gear 29 and passive gear 28. The casing 211 will then rise to a certain sloped condition as shown in the dotted line in Fig. 2A. When the desired slope is reached, then the limit switch 271 representing that slope is touched and pressed by the protrusion 241 on the racks 24. Then, 24, the motor 21 will stop and the track means 1 will remain at that slope. There is a photo counter 26 provided close to the axle 22 for detecting the slope data and inputting the data to the controller 3.

Referring to Fig. 3 which is an illustrative view of the treadmill, the chest portion of the user will receive and reflect the wave transmitted by the supersonic device 34 on the controller 3. If the running speed of the user is faster than the speed of the belt 12, for example, if the user is at A position Da < D, the controller 3 will accelerate the speed of the belt 12 each time by a certain amount of speed unit. Vice versa, if the running speed of the user is slower than the speed of the belt 12, i.e. Db > D, the controller 3 will automatically slow down the belt speed.

A microprocessor preprogrammed with software is provided within the controller 3. The various programs for different functions will be described hereinafter. Now, referring to Fig. 4, the particular flow chart is detailed for the speed controlling program. It is easily understood by the flow chart how the speed of the belt is accelerated or decelerated.

Referring now to Fig. 5 with reference to Fig. 1, on column 4 is formed height adjusting means 41. The column 4 actually consists of an inner tuber 414 and an outer tuber 415 clamped by a nut 411. There is a grip 413 on the outer tube 415 touching the tapered portion 412 of the nut 411. When the nut 411 is turned lose, the grip 413 on the outer tube 415 is released due to its flexibility. Thus, the inner tube 414 and outer tube 415 may be moved relative to each other to adjust the height of the column 4. After the desired height is reached, one can turn tight the nut 411 for a tight fit between the inner and outer tubes. Referring particularly to Fig. 1, there are safety membrane switches 42 formed on the column 4. The user must grip the safety switches 42 to start operation of the treadmill. This serves as a safety guard for the user, especially in therapy.

Referring to Fig. 6 which shows a perspective view of the pulse rate detector and the detector of number of steps taken, the pulse rate detector 71 is clamped to any fingertip, preferably, the thumb, to sense the pulse, and the detector 72 is hung on the user's body for sensing the number of steps taken. Both detectors are linked together through electric wires 73, 74 and connected to the controller 3 by an adapter 75.

Referring to Fig. 7 which shows a structural diagram of the functions of the treadmill, the central process unit or a microprocessor 80 is connected to different control means such as setting/display panel 33 for setting and displaying data. By track driving means 81 and slope adjusting means 82, the functions of track belt rotation control and slope control will be executed. The data sensed by slope counter 82 (26), distance counter 84 and supersonic detecting device 87 (34) serves as reference for controlling the slope and the speed. Collecting the data sensed by the distance counter 84 (16) and counter of mumber of steps 85 (72), the microprocessor 80 can store or display data concerns distance, number of steps taken and the pace. With the pulse rate detector 86 (71), pulse rate data may be collected and processed by the micro-

processor 80. The functions that microprocessor 80 can perform are briefly listed on Fig. 7 but a detailed list of possible functions can be found in Table 1. Those functions operable before starting the track rotation operation are listed in Table 3. Functions operable during track rotation are listed in Table 4. Functions operable during interruption of the rotation are listed in Table 5.

Referring to Fig. 8 which shows the diagram of the front panel of the controller 3 of the treadmill, there are a name plate 331, a belt speed meter 332 and display panel 333 on the upper portion. The display panel 333 further consists of a display 334 for number of steps, pace, heat dissipated and slope, a display 335 for distance and time, and a display 336 for pulse rate. The middle portion of the panel 33 has a set of input and control keys 342 on the right and lights together with specifications on the left. There are warning signal light group 337, operation status lights group 338, data input lights group 339, slope indication lights group 340 and memory data display lights group 341 shown on the controller panel 33. There are other buttons for power, ON, OFF and control button START, INTERRUPTION, and TERMINATION shown on the botton portion of the panel 33.

When the user wants to exercise on the treadmill, he must first touch "the operation mode" button and choose the operation mode displayed desired from the operation status lights group 338, Then, he pushes the input key 342 for inputting all the necessary exercise data such as an identification code, weight, age, distance to be covered, period of exercise, speed, etc., indicated in the data input lights group 339. After data are input, the user then pushes the START button, causing the treadmill to start operation in accordance with the pre-stored reference data, and as the treadmill operates the microprocessor 80 will continue to perform all the functions possible, such as adjusting speed/slope, generating warning signals, displaying exercise data, etc.

There are programs for different functions stored in the microprocessor 80 which are listed in Table 5, and the flow charts for these programs are shown respectively in Fig. 9 through Fig. 20. The functions and their associated programs/flow charts are quite self-explanatory and thus will not be detailed further. However, it is to be understood and noted that further possible functions can still be very easily developed and added to the treadmill of the present invention.

The treadmill of the present invention has been described hereinabove by way of a preferred embodiment; it is to be noted that changes, improvements, and modifications can still be made without departing from the scope of the present invention.

Table 1. List of possible functions of the treadmill

1. Selection of exercise or therapeutic function
2. Selection among functions of distance covered, duration of exercise or program mode
3. Selection among functions of number of steps taken, pace, heat dissipated or slope adjustment
4. Setting operation data function
5. Repeating operation function
6. Displaying memory data function
7. Clearing memory of data function
8. Slopes adjustment
9. Starting operation function
10. Interrupting operation function
11. Terminating operation function
12. Searching forward for data in memory
13. Searching backward for data in memory
14. Monitoring exercise data function

Table 2. List of functions performable before starting rotation operation

1. Selection of exercise or therapeutic function
2. Selection among functions of distance covered, duration of exercise or program mode
3. Selection among functions of number of steps taken, pace, heat dissipated or slope adjustment
4. Setting operation data function
5. Repeating operation function
6. Displaying memory data function
7. Clearing memory of data function
8. Slopes adjustment
9. Starting operation function
10. Searching forward for data in memory
11. Searching backward for data in memory

Table 3. List of functions performable during rotation operation

1. Interrupting operation function
2. Terminating operation function
3. Monitoring exercise data function

Table 4. List of functions performable during interruption

1. Selection among functions of number of steps taken, pace, heat dissipated or slope adjustment
2. Displaying memory data function
3. Searching forward for data in memory
4. Search backward for data in memory
5. Slopes adjustment
6. Starting operation function
7. Terminating operation function

Table 5. Software Modes of Treadmill

1. System starting condition setting mode
2. Periphery data inputting mode
3. Operation modes selecting mode
4. Monitor items selecting mode
5. Exercise data setting mode
6. Permission for starting mode ;q;7. Exercise repeating mode
8. Memory data displaying mode
9. Memory data clearing mode
10. Slope adjusting mode

11. Data backward-searching mode
12. Data forward-searching mode
13. Operation starting mode
14. Operation interruption mode
15. Operation termination mode
16. Exercise data monitoring mode
17. Periphery data outputting mode
18. Exercise duration interrupting mode

CLAIMS

1. A treadmill characterized by:

a track means having a rotatable belt for user to stand upon;

a driving means with a power apparatus connected to said track means for driving the belt thereof to rotate within a zero to a predetermined maximum speed;

a slope adjusting means associated with said track means to incline the same;

a microprocesssor controlling means having stored therein software programs corresponding to a function and a control arrangement for the function, said controlling means further including data input means for inputting reference control data, data storage means to store data, and display means to display data; and

exercise data detecting means to sense exercise data and input the same to said controlling means;

whereby, said track means will be induced by said controlling means to change the slope and also the speed of rotation of the belt thereof.

2. A treadmill according to Claim 1 wherein said slope adjusting means further includes:

rack members having a protrusion formed thereon;

driving means having an active driving gear coupled with said rack members; and

a plurality of limit switches representing different slopes, formed adjacent to said rack members for reaching to a touch by said protrusions so as to stop the driving means;

thereby, said track means will stop at a predetermined slope position.

3. A treadmill according to Claim 1 wherein said track means further comprises a plurality of columns installed at each side thereof for being held by the user during exercise.

4. A treadmill according to Claim 1 wherein said exercise data detecting means includes means for measuring rotation distance of the belt.

5. A treadmill according to Claim 4 wherein said means for measuring the rotation distance is a photo counter.

6. A treadmill according to Claim 3 wherein said exercise data detecting means includes means for detecting user's position and means for inputting data of user's position to said controlling means.

7. A treadmill according to Claim 6 wherein said means for detecting user's position is a supersonic transmitter and receiver.

8. A treadmill according to Claim 3 wherein said exercise data detecting means further includes means for detecting the number of steps taken by the user and means for inputting data concerning the number of steps taken to said controlling means.

9. A treadmill according to Claim 8 wherein said means for detecting the number of steps is a photo counter.

10. A treadmill according to Claim 8 wherein said means for detecting the number of steps is a vibration sensor hung on the body of the user.

11. A treadmill according to Claim 3 wherein said exercise data detecting means further includes a pulse rate detecting means to detect a pulse rate of the user, and means for inputting data concerning the pulse rate to said controlling means.

12. A treadmill according to Claim 11 wherein said pulse rate detecting means is a pulse rate sensor clamped on a finger tip of the user.

13. A treadmill according to Claim 1 further including a warning means to generate a warning signal when the operating condition of the treadmill is unsuitable for the user.

14. A treadmill according to Claim 3 wherein said track means further includes a plurality of fitting holes formed therein for the installation of said columns.

15. A treadmill according to Claim 3 wherein said columns includes height adjusting means for adjusting the height of the columns for different users; said adjusting means including a flexible grip and a nut with an inner tapered portion for tightening or loosening said grip.

16. A treadmill according to Claim 3 further including a plurality of safety switches formed on said columns; said safety switches turning ON only when the user holds the columns; so that the treadmill will terminate operation when the user's hand leaves the columns.

17. A treadmill according to Claim 1 wherein said data input means of the controlling means includes a set of data entry keys for inputting data concerning the exercise modes, user's identification code, distance, period of exercise, speed, etc,.

18. A treadmill according to Claim 1 wherein said function/control arrangement includes means for inputting/outputting exercise data; said output means including light groups, alarms and a digital display.

19. A treadmill according to Claim 1 wherein said function/control arrangement within said controlling means further includes means for setting operation modes which may be a distance mode, a duration of exercise mode, a heat dissipation mode, a program mode, and a repeat operation mode.

20. A treadmill according Claim 19 wherein said function/control arrangement will control the distance rotated by said belt of the track

means when the exercise mode is set at the distance mode.

21. A treadmill according to Claim 19 wherein said function/control arrangement will further control a period of operation of the belt of the track means when the exercise mode is set at the duration mode.

22. A treadmill according to Claim 19 wherein said function/control arrangement will further control the track means to operate in accordance with a predetermined program when the exercise mode is set at program mode.

23. A treadmill according to Claim 1 wherein said function/control arrangement further includes means for monitoring exercise conditions which may be distance, time, number of steps, heat dissipation, pulse rate, speed of belt rotation, slope of track means and rate of slope change.

24. A treadmill according to Claim 23 wherein said monitoring means includes means for selecting items to be monitored.

25. A treadmill according to Claim 1 wherein said function/control arrangement within said controlling means further includes means for inspecting the exercise data in the storage means.

26. A treadmill according to Claim 1 wherein said function/control arrangement within said controlling means further includes means for controlling the change of speed and slope of the track means.

27. A treadmill according to Claim 1 wherein said function/control arrangement within said controlling means further includes warning means to generate an output warning signal when the data concerning the pulse rate of the user is abnormal, said warning signal also being generated during a change of speed and slope of the track means, and whereby, when the pulse rate is too high, the track driving means will cease operation.

28. A treadmill according to Claim 1 wherein said function/control arrangement wiwthin said controlling means further includes means for controlling the start, interruption and cessation of the operation.

29. A treadmill as substantially described hereinbefore with reference to the accompanying drawings.

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